

TOO MUCH
TOO LITTLE
TOO QUALITY



Integrated Water Resources Science and Services (IWRSS)

*Collaborative Science, Services and Tools to Support
Integrated and Adaptive Water Resources Management*

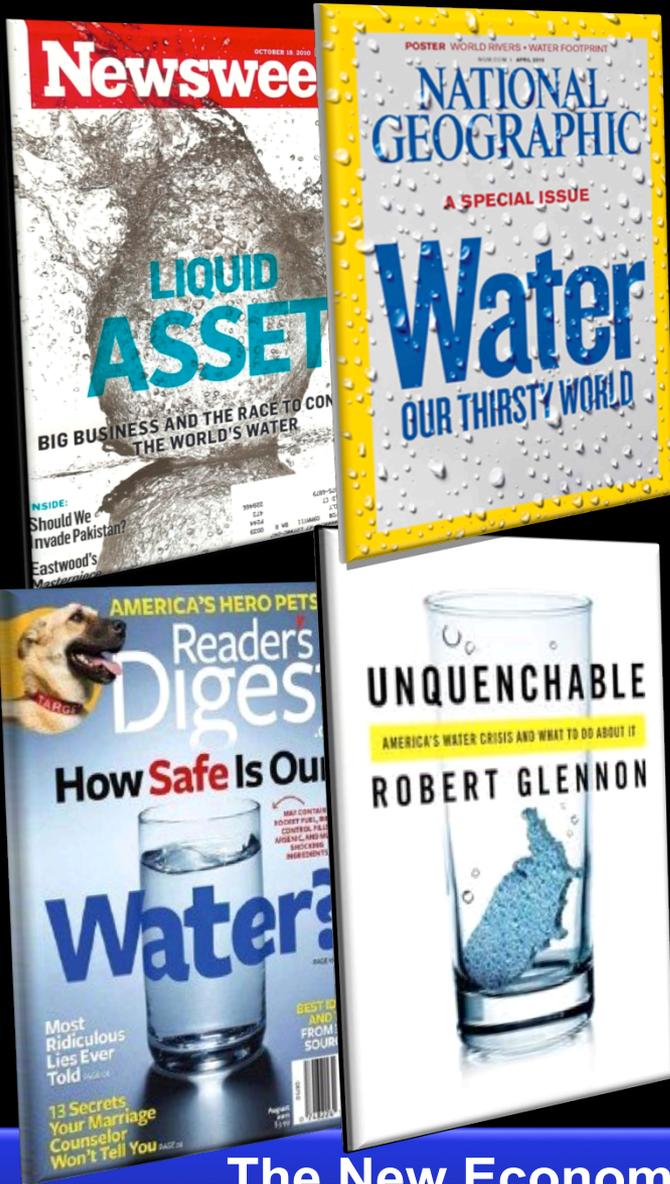
Don Cline
Chief, National Weather Service
Hydrology Laboratory



August 30, 2011



Growing Water Challenges



National Imperative

- *Protect Life and Property*
- *Support Economic Security*
- *Protect Health and Environment*
- *Mitigate Escalating Risk*

Triple Threat

- **Population growth and economic development** are stressing water supplies and increasing vulnerability
- **Climate variability and change** is impacting water availability and quality, increasing uncertainty
- **Aging water infrastructure** is forcing critical, expensive decisions

The New Economics of Water: Blue Gold, “The New Oil”



Growing Water Challenges



• Floods

- The annual average damage due to flooding has risen each of the past three decades (costs adjusted for inflation)
 - 1981-1990: \$4.7 Billion
 - 1991-2000: \$7.9 Billion
 - 2001-2010: \$10.2 Billion
- 2011 combined flood losses along the Mississippi and Missouri Rivers are expected to exceed \$6 Billion (USA TODAY; USACE)

• Drought

- US drought in 2011 rivals the Dust Bowl – 25% of country experiencing severe drought (New York Times)
- 2011 impacts in Texas alone are expected to exceed \$3 Billion (Associated Press)





Growing Water Challenges



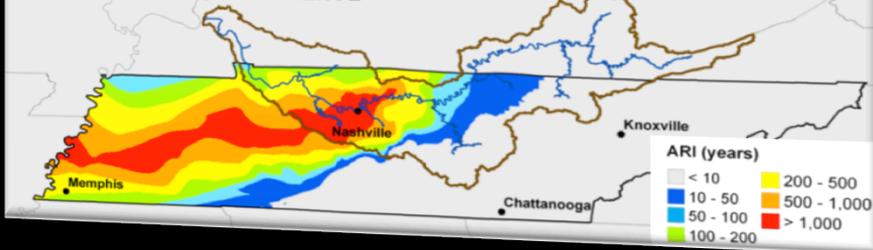
Nashville, TN May 1-3, 2010

- 10-16 inches of rain in 36 hours
- 31 fatalities
- \$2.3 billion in damages

48-HR TOTAL PRECIPITATION



48-HR CHANCE OF OCCURRENCE



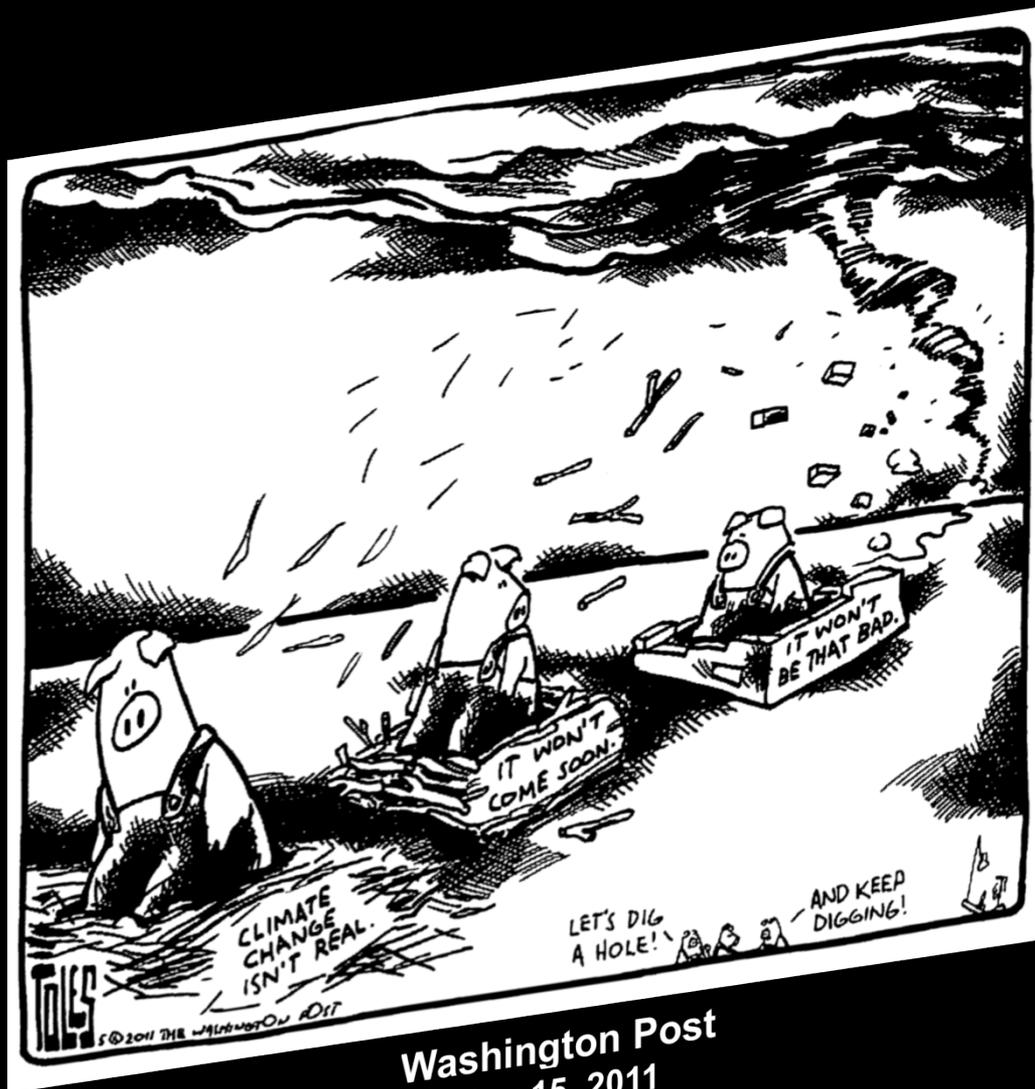
Issue: NWS, USACE, and USGS were not able to share information and communicate in an effective manner during the peak of the event

Action: *Facilitate improved access to data and ensure common operating picture*

Issue: City officials and the public were not aware of devastating impacts until they occurred - severity and extent of inundation not communicated effectively

Action: *Implement comprehensive flood forecast inundation mapping system*

Growing Water Challenges



Washington Post
May 15, 2011

“Stationarity –
the idea that natural
systems fluctuate within
an unchanging envelope
of variability –
is dead”

Science Magazine
February 1, 2008

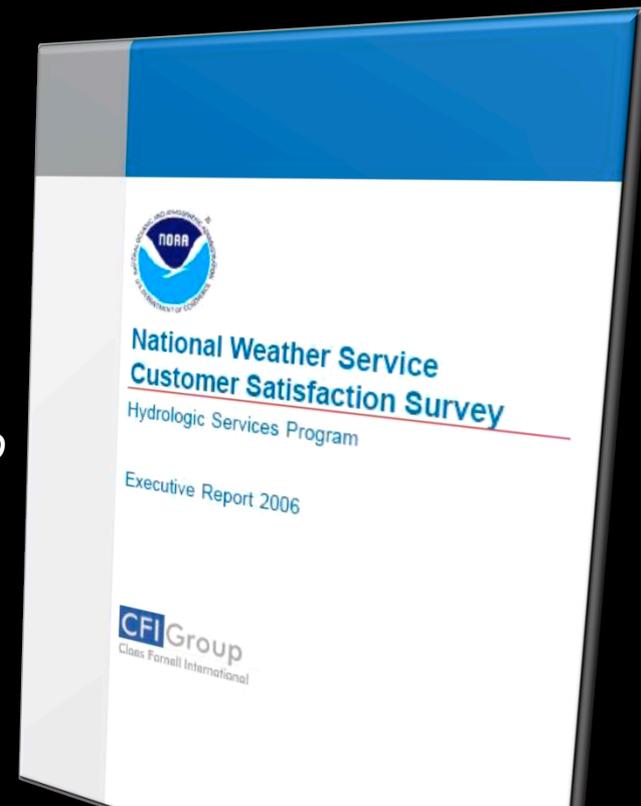
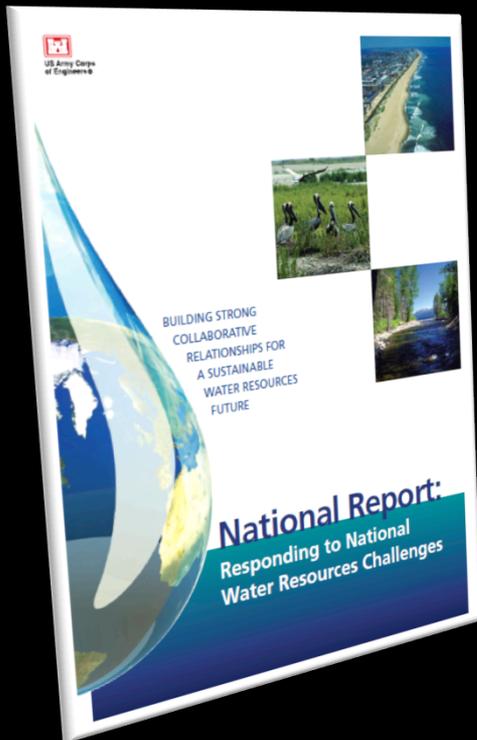


What Our Stakeholders Say



Decision-makers in water management sectors need:

- Expanded/new high resolution water information in space and time to inform decisions
- Simplified access to better integrated information
- Quantification of uncertainty to manage risk
- Enhanced communication of flood risk using flood forecast maps



NWS completed extensive outreach to objectively define, validate and prioritize stakeholder needs

- Partnered with Claes Fornell International (CFI) Group and David Ford Consulting Engineers
 - surveyed users of NOAA's hydrologic information via the American Customer Satisfaction Index (2002, 2004, 2006, 2008, 2011)
 - carried out national surveys and targeted user forums with emergency managers, private sector, media, and water resources managers

USACE conducted National Needs Assessment for all 50 States



Example: New York City



Strategy: \$5M Water Management Information System
Alternative: \$8-10B Infrastructure Improvements

- NYC DEP is implementing a \$5M water resources management decision-support system in an effort to improve turbidity control and balance multiple objectives
 - Drinking water for population of 9 million
 - Flood control for 20 million people
 - Environment/ecosystems (peak flow control, habitat flows)
- The system requires comprehensive hydrologic and water resources information and forecasts to better anticipate and manage conditions affecting water quality

- The alternative: If strict water quality thresholds are exceeded, NYC faces \$8-10B in construction costs and hundreds of millions in annual operating costs for filtration plants, new multilevel reservoir intakes, and other structures
- Very high political visibility
- NYC is partnering with NWS to provide the necessary hydrologic information and forecasts





NOAA's Strategic Plan





Grand Challenge

Deliver enhanced water information to:

- ✓ Understand water availability, threats, and uncertainties
- ✓ Help decision makers understand and reduce risk
- ✓ Improve social and economic security
- ✓ Support the growing water economy

How?



Integrated Water Resources Science and Services Five-Point Strategy



Innovative Federal Consortium

- New business model for interagency collaboration
- Leverage investments
- Common Operating Picture

Enriched Stakeholder Participation

- Enable and support regional service agents
- Strengthen participatory processes
- Develop social capital

New Digital Information Products

- Summit to Sea
- Floods to Droughts
- Past, Present and Future
- Extend range, improve accuracy, quantify uncertainty

Single Portal for Water Information

- One-stop shopping
- Federal Toolbox for forecasts, data, maps, policies, programs

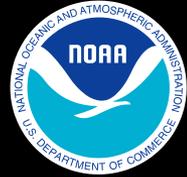
National Water Center

- New bricks and mortar facility
- Synthesis and Integration
- Multi-agency staffing





IWRSS Roadmap



A new business model for interagency collaboration in the information age



Integrated Water Resources Science and Services (IWRSS)

An Integrated and Adaptive Roadmap for Operational Implementation

Don Cline, NOAA (Compilation)
IWRSS Workshop Participants (NOAA, USACE, USGS)
Cross-cutting Theme Teams for Human Dimensions and
Technical Information Services
Regional Case Study Contributors



DRAFT v1.1
February, 2009

- Partner and co-invest to solve large problems
- Leverage multi-disciplinary skills to formulate effective solutions
 - Enable cross-agency teams to be able to solve problems holistically
 - Develop Common Operating Picture through system interoperability, standardized data, and collaborative tools

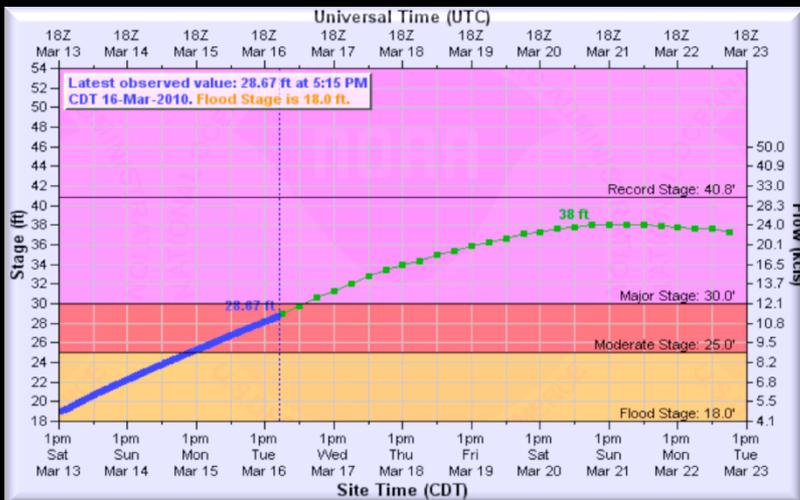


New Digital Information Products



TODAY

- Conventional river forecast predicts water elevation at river gage (single point) over time
- Static inundation maps show flood areas corresponding to a set of water elevations
 - Only available for small minority of river forecast locations and do not depict actual flood wave
- User must understand the forecast hydrograph, then examine static maps, then estimate impacts using other means



Conventional Flood Forecast Hydrograph

Inundation Levels
 Flood Categories
 Current/Forecast

Inundation Levels
 NAVD88 Stage
409.9 40.7
 408.0 38.8
 407.2 38.0
 406.5 37.3
 405.7 36.5
 404.2 35.0
 403.4 34.2
 402.6 33.4

Major Flooding Begins
 401.8 32.6
 401.2 32.0
 400.4 31.2
 398.7 29.5
 397.8 28.6

Moderate Flooding Begins
 396.9 27.7
 396.0 26.8
 395.2 26.0
 394.2 25.0

Minor Flooding Begins
 393.2 24.0
 392.3 23.1

Near Flooding Begins
 391.4 22.2
 389.5 20.3
 387.9 18.7

Inundation Feedback

Image Type: Standard (Faster Download) Detailed (Slower Download)
 Current Stage: 5.63 at 12:00 UTC 07/25

Selected Inundation
 NAVD88: 409.9 ft
 Stage: 40.7 ft

Mouse Location*
 Water Depth: Off
 Latitude: 41.3409 N
 Longitude: -74.8091 W
 * All mouse location values are estimates only.

Print / Save Image
 About Inundation
 Download Dataset(s)
 FAQ
 User Guide
 Inundation Sites

Flood Categories (in feet)
 Major Flood Stage 33
 Moderate Flood Stage 28
 Minor Flood Stage 25
 Near Flood Stage 23
 Below Flood Stage

USGS Gauge Location
 Extent of Inundation Study Boundaries

Historical Crests
 (1) 35.5 ft on 10/10/1903
 (2) 35.15 ft on 08/19/1955
 (3) 32.16 ft on 06/29/2006
 (4) 31.69 ft on 04/03/2005
 (5) 28.45 ft on 03/18/1936
 (6) 26.61 ft on 01/20/1996
 (7) 25.7 ft on 05/23/1942
 (8) 24.33 ft on 04/01/1940
 (9) 23.4 ft on 06/30/1973
 (10) 23.28 ft on 03/15/1986



New Digital Information Products



IWRSS Initial Proof-of-Concept: Multi-Agency Collaboration to Increase Capacity and Stakeholder Benefit

- NWS Static Maps to be hosted by USGS with superior interface for Emergency Managers
- Maps linked to GIS framework and FEMA's HAZUS database
 - ✓ Reports impacts of flood inundation, including:
 - ✓ Population Affected
 - ✓ Built Infrastructure Risk
 - ✓ Shelter Requirements
 - ✓ Economic Loss Risk
- User experience will be improved by linking maps to impacts
- To be completed early 2012

USGS
science for a changing world

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Functionality Testbed Only - Flood Inundation Mapping and Risk Assessment: Flint River at Albany, Georgia

Background Map

Type address or place of interest... Go

FEMA HAZUS HAZUS Reports

Report Scope: Entire Region Census Block

Quick Assessment: Inventory Buildings Lifelines Debris

Study Region: Dougherty County, GA
Scenario: Stage 37

Regional Statistics

Area (Square Miles)	329
Number of Census Blocks	1,917
Number of Buildings	
Residential	34,321
Total	37,733
Number of People in the Region (x 1)	96,000
Building Exposure (\$ Millions)	
Residential	4,038
Total	5,818

Scenario Results

Shelter Requirements

Displaced Population (# Households)	2230.0
Short Term Shelter (# People)	6433.0

Economic Loss

Residential Property (Capital Stock) Losses (\$ Millions)	85.0
Total Property (Capital Stock) Losses (\$ Millions)	127.0
Business Interruptions (Income) Losses (\$ Millions)	1.0

Stage in Feet, Flint River at Albany, GA
30 31 32 33 34 35 36 37 38 39 40 41 42 43

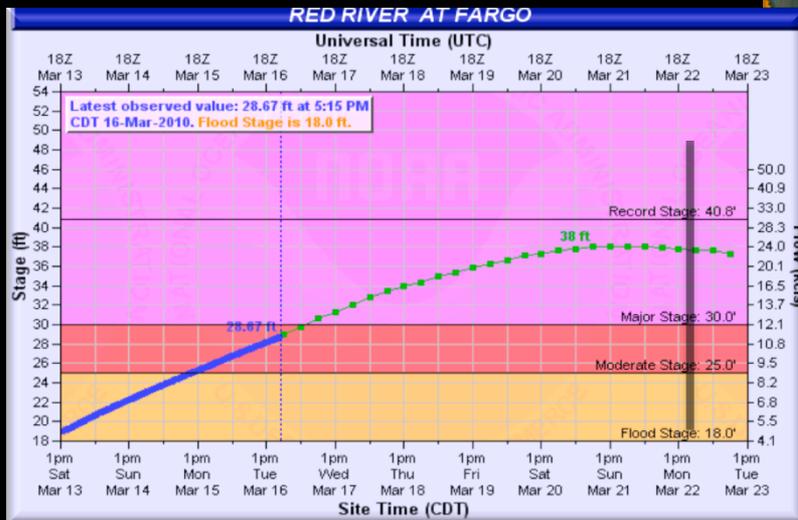
Wipe Inundation Layer

HAZUS Reports

New Digital Information Products

Planned for FY13 – FY16: Maps Linked to River Forecasts, Updated Every 6 Hours

- 2011 Multi-Agency Collaboration Proof of Concept will be linked to actual river forecasts
- Builds on successful Fargo ND Pilot Project, demonstrating dynamic forecast maps updated 4X / Day
- Actual flood wave is forecasted and depicted



Forecast is for gauge 1.7 miles upstream

Conventional Flood Forecast Hydrograph



New Digital Information Products

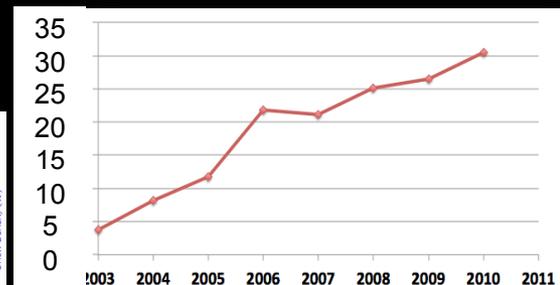
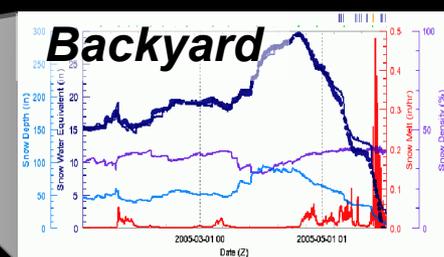
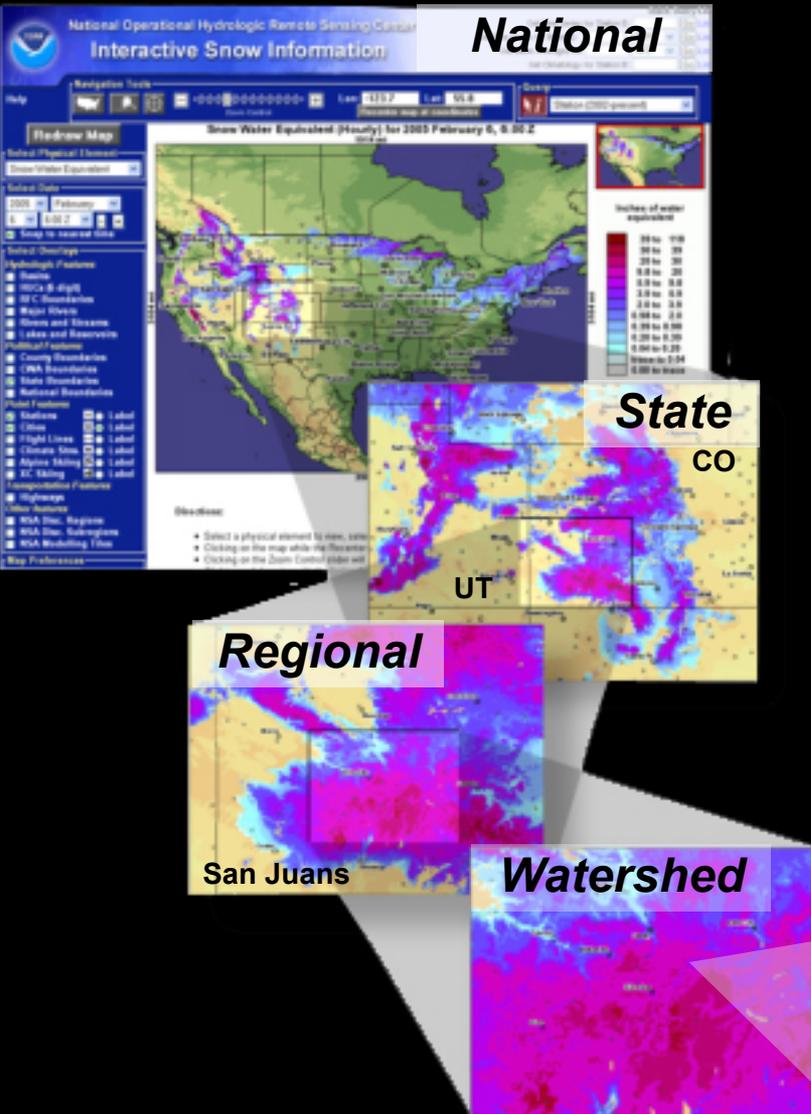


Today: Summit-to-Sea Pilot

NATIONAL SNOW ANALYSES

Integrating Multi-Agency Data and Models to Provide Consistent Water Resource Information

- Integrates all available snow data – from multi-agency snow observing networks (e.g. USDA SNOTEL), NWS airborne sensors, and NOAA and NASA satellites – into state-of-the-art snow physics model from USACE
- NWS operations framework incorporates NWS weather information into model to provide summit-to-sea snowpack monitoring and forecasts
- 1-km, hourly resolution products (snow depth, water content, snowpack temperature, snowmelt rate, etc.) widely used in government, private and public sectors



Peak Monthly Web Traffic (Million Hits/Month)

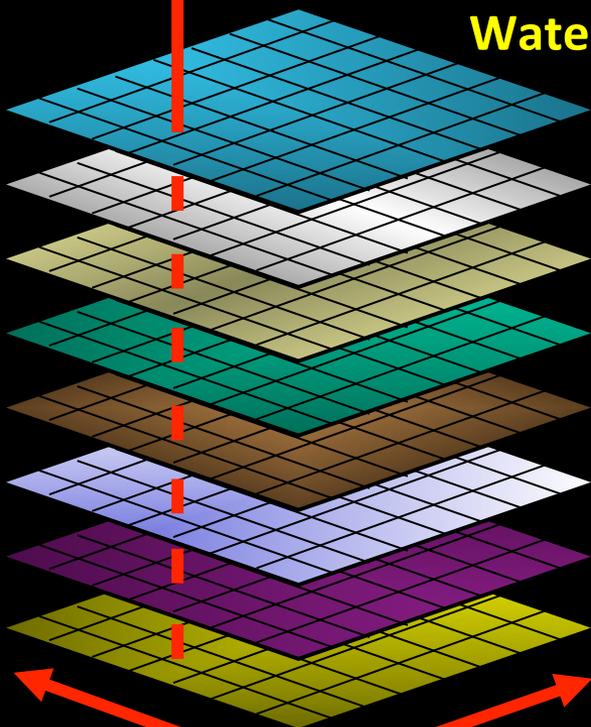


New Digital Information Products



Planned for FY13 – FY16: Soil Moisture and Evapotranspiration Added to Suite

Local Information (<1 km²)



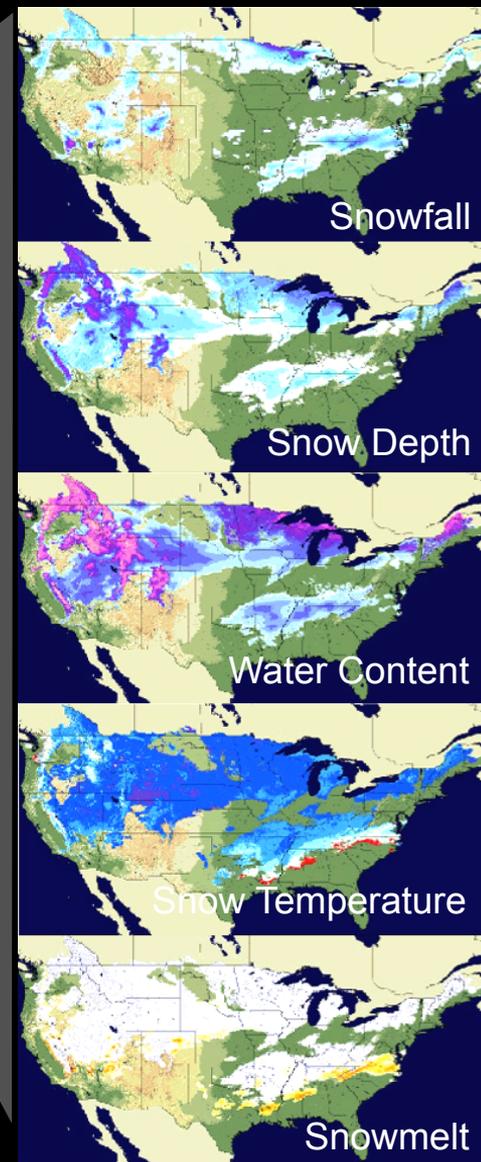
Summit-to-Sea Water Resources Products

- Precipitation
- Snowpack
- Soil Moisture
- Evapotranspiration
- Groundwater
- River flow
- Surface Storage
- Water Quality

Watershed – to – National Information



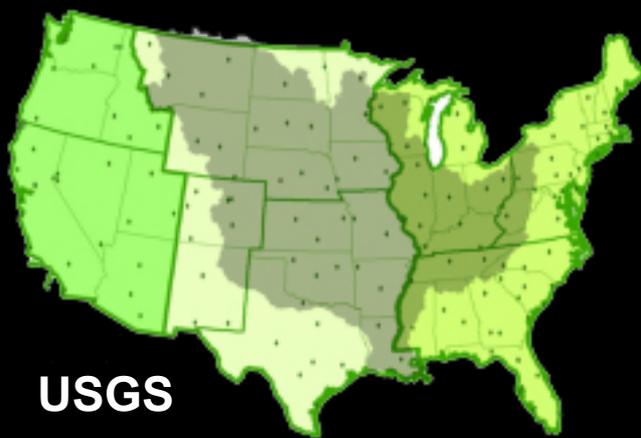
Pilot Products - Snowpack



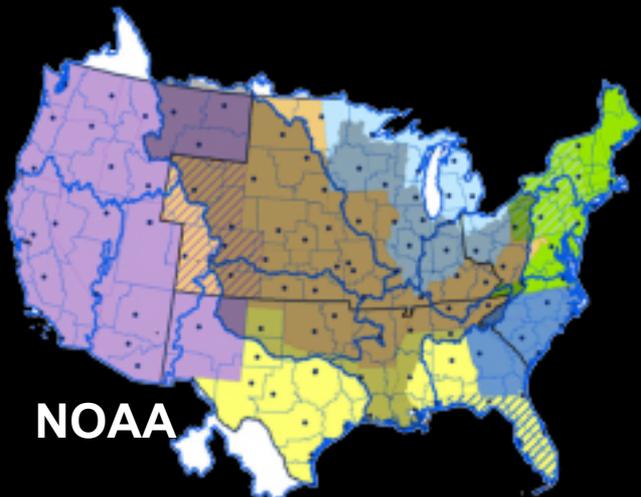
Implementing the New Business Model



USACE



USGS



NOAA

Mississippi Basin: 250 Entities

- 31 States
- 6 NOAA Regions
- 4 NWS Regions
- 5 NWS River Forecast Centers
- 65 NWS Weather Forecast Offices
- 5 USACE Divisions
- 20 USACE Districts
- 2 USGS Regions
- 6 USGS Sub-regions
- 92 USGS Water Science Centers
- A handful laboratories and headquarters offices



Implementing the New Business Model



Today

- 24 Federal Agencies have a role in fresh water
- Operations support coordinated through NWS Rivers Forecast Centers and Weather Forecast Offices, USGS Science Centers, USACE District Offices
- Unique, non-standard exchange mechanisms for critical data (email, phone and web are common)
- Limited sharing of technology, modeling capabilities and expertise
- R2O activities often time and labor intensive
- Limited coordination of R&D investments
- No national operational center exists for water forecasting, analysis, and coordination across organizational and geographic boundaries

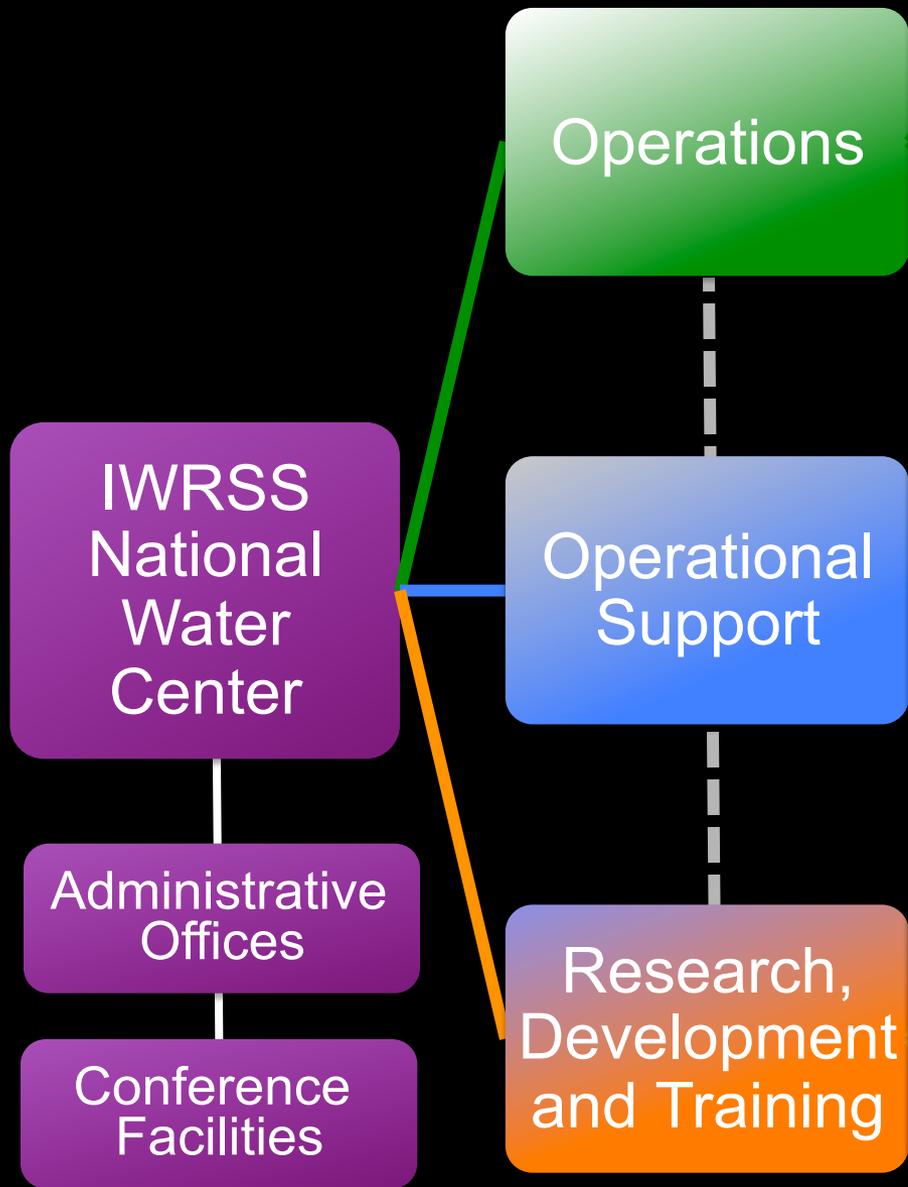


Implementing the New Business Model



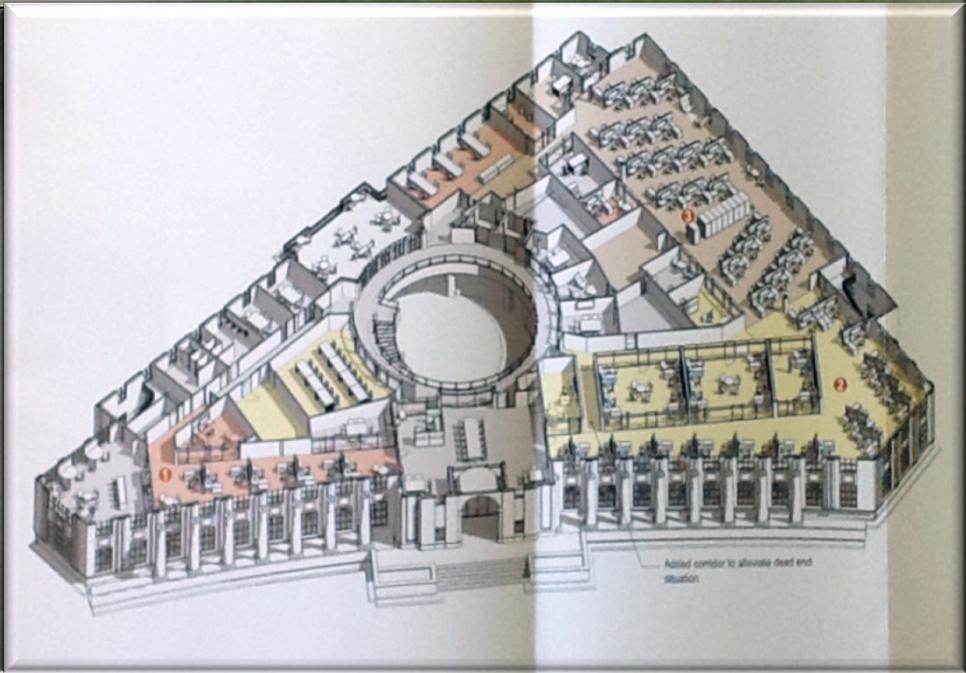
Planned for FY13 - FY16:

- NOAA is constructing the IWRSS National Water Center (NWC)
 - Functions of NWC described in February 2009 IWRSS Roadmap
 - Catalyst to expedite implementation of new/enhanced sector-specific services to enable routine, high value decision making
 - e.g., floodplain management, emergency management, agriculture, water supply, transportation, energy, ecosystems, human health
 - 60,000 SF facility (full occupancy = 200)
- Capabilities
 - Joint Agency Coordination and Collaboration, Common Operating Picture
 - High Resolution Hydrologic Analyses, Forecasts and Field Guidance
 - Dynamic Flood Inundation Mapping
 - Multi-agency Interoperability
 - National Portal for Water Resources Information
- Groundbreaking is expected in FY12, completion in FY13





IWRSS National Water Center





Summary



Integrated Water Resources Science and Services

- New business model for interagency collaboration
- Share technology, information, models, best practices
- Started with three agencies, designed to expand
- Members agree to work toward:
 - ✓ *Interoperability of key systems and data synchronization*
 - ✓ *Standardized data formats*
 - ✓ *Enhanced geospatial information and visualization*
 - ✓ *Coordinated R&D portfolio investments*
 - ✓ *Leverage multi-disciplinary skills to formulate effective solutions*
 - ✓ *One stop shopping for federal water data and information*

